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PATENTS.

THE chances of a reform in the Patent Laws being thoroughly discussed in Parliament seem to grow less and less each succeeding session, and although considerable pressure is no doubt brought to bear upon the authorities with whom the question of reform rests, the matter has practically made no progress at all. The general tendency of the age is to cheapen every convenience to the public which is carried on under Government management. The Post has long been reformed in this respect; some forty years have passed since the postage of a letter was reduced from one shilling to one penny. The Telegraph is almost immediately to be reformed in this direction, but the tax on Patents, which has been a clog to inventors in this country, seems as far as ever from being reduced to reasonable dimensions. At the present time a man who so far loses control over himself as to commit an assault upon one of his fellow-creatures, is fined a few shillings for the deed, whereas, any one who is audacious enough to protect the conception of his brain is fined from £50 to £200 for leave to do so. Inventors know full well that any invention of value, if brought to public notice without being protected, is practically money put into other people's pockets and none into their own, and being in very many cases unwilling or unable to command such a sum as £50—for a patent is of little or no value unless valid for at least three years—they prefer to keep their ideas to themselves.

The arguments against the patent laws, as they at present exist, are so numerous, and have been brought forward so often, that but little more can be said against them. What is wanted is a continual agitation and pressure brought to bear until something is done. Statistics of patents taken out in the United States bear eloquent testimony to the value of a patent with low fees. The inventive genius of the American is proverbial, and although it cannot be said for certain that this is due to the satisfactory state of the patent law in the United States, yet it is a very general opinion that it has much to do with it. It would almost appear that the object of the patent laws in England is to discourage invention as much as possible. The laws are certainly not such as to encourage it.

At the present day, when foreign competition is so keen in every branch of practical science, it is of the highest importance to the welfare of the nation that every encouragement should be given to invention. The subject is, no doubt, a difficult one to deal with properly, and cannot be settled off-hand, as many imagine, but it is none the less urgent on that account.

THE BRITISH ASSOCIATION MEETING.

(Continued from page 289.)

AT each stage of the process there must be a considerable absorption of heat to produce the change of state, and our supply of heat is limited in the electric arc because of the dissociation of the conductors, and more limited still in quantity in the electric spark or in the discharge through a vacuum tube, also we should expect a recombination of the dissociated substances immediately after they have been first dissociated. Hence it seems easier to suppose that at temperatures which we can command on the earth, the dissociation of molecules by the arc or the spark is accompanied by the formation of new compounds, in the formation of which heat and light, and especially chemical vibrations, would be again given out, giving rise to new spectra, rather than to suppose that we can reach the temperature necessary for successive stages of dissociation.

To the lines C, F, the line near G and *h* belonging to hydrogen, which have a certain rhythmical character, Mr. Lockyer adds D_3 and Kirchoff's line "1474," regarding "1474" (wave-length) as belonging to the coolest or most complex form, and rising to F, which is again subdivided into C and G, using the spark without a condenser, which again gives *h* with the spark and condenser, which is again split up and gives D_3, a more simple line than *h*, in the chromosphere. Professors Liveing and Dewar, on the other hand, trace a rhythmical character or ratio between three of the brightest lines of the chromosphere, two of which are lines "1474" and "f" of Lorenzoni, similar to the character of C, F, and *h* of hydrogen, and also trace a similar relation between the chromospheric line D_3 and "1474" to the ratio of the wave-lengths of F and the line near G. They infer the probability that these four lines are due to the same at present unknown substance as had been suggested by Young with regard to two of them.

The harmony of this arrangement is somewhat disturbed by the fact that D_3 lies on the wrong side of "1474" to correspond with the line near G of the hydrogen spectrum.

If we inquire what our sun and the stars have to say to these changes of spectra of the same substance at different temperatures, Dr. Huggins gives us the answer.

In the stars which gives a very *white* light, such as Sirius or *a* Lyræ, we have the lines G and *h* of hydrogen and also H^1, which has been shown by Dr. Vogel to be coincident with a line of hydrogen; but the K line of calcium is weak in *a* Lyræ, and does not appear in Sirius. In passing from the white or hottest stars to the yellow stars like our sun, the typical lines diminish in breadth and are better defined, and K becomes stronger relatively to H, and other lines appear. In Arcturus we have a star which is probably cooler than our sun, and in it the line K is stronger in relation to H than it is in the solar spectrum, both being very

strong compared with their state in the solar spectrum.

Professors Liveing and Dewar find that K is more easily reversed than H in the electric arc, which agrees with the idea that this line is produced at a lower temperature than H.

Besides the absence or weakness of K, the white stars have twelve strong lines winged at the edges, in which there are three of hydrogen, viz., G, *h*, and H, and the remaining nine form a group which are so related to one another that Dr. Huggins concludes they probably belong to one substance. Three of these lines are said by Dr. Vogel to be lines of hydrogen.

Liveing and Dewar have made considerable progress in determining the conditions and the order of reversal of the spectral lines of metallic vapours. They have adopted methods which allow them to observe through greater thicknesses of vapour than previous observers have generally employed. For lower temperatures tubes of iron or other material placed vertically in a furnace were used, and the hot bottom of the tube was the source of light, the absorption being produced by vapours of metals dropped into the hot tube and filling it to a greater or less height. By this means many of the more volatile metals, such as sodium, thallium, iridium, cæsium, and rubidium, magnesium, lithium, barium, strontium, and calcium, each gave a reversal of its most characteristic line or pair of lines, *i.e.*, the red line of lithium, the voilet lines of rubidium and calcium, the blue line of strontium, the sharp green line of barium (5535), and no other lines which can certainly be ascribed to those metals in the elementary state.

For higher temperatures tubes bored out in blocks of lime or of gas carbon, and heated by the electric arc, were used. By keeping up a a supply of metal and in some cases assisting its volatilisation by the admixture of a more volatile metal, such as magnesium, and its reduction by some easily oxidisable metal, such as aluminium, or by a current of coal gas or hydrogen, they succeeded in maintaining a stream of vapour through the tube so as to reverse a great many lines. In this way the greater part of the bright lines of the metals of the alkalies and alkaline earths were reversed, as well as some of the strongest lines of manganese, aluminium, zinc, cadmium, silver, copper, bismuth, and the two characteristic lines of iridium and of gallium. By passing an iron wire into the arc through a perforated carbon electrode they succeeded in obtaining the reversal of many of the lines of iron. In observing bright line spectra they have found that the arc produced by a De Meritens machine arranged for high tension gives, in an atmosphere of hydrogen, the lines C and F, although the arc of a powerful Siemens machine does not bring them out, and they have observed many metallic lines in the arc which had not been previously noticed. The temperature obtained by the De Meritens machine is thus higher than that obtained in the Siemens machine.

From observations on weighed quantities of sodium, alone and as an amalgam, introduced into a hot bottle of platinum filled with nitrogen, of which the pressure was varied by an air-pump, they conclude that the width of the sodium lines depends rather on the thickness and temperature of the vapour than upon the whole quantity of sodium present. Very minute quantities diffused into the cool part of the tube give a broad diffuse absorption, while a thin layer of compressed vapour in the hot part of the tube gives only narrow absorption lines. Professors Liveing and Dewar have observed the reversal of some of the well-known bands of the oxides and chlorides of the alkaline earth metals. The lines produced by magnesium in hydrogen form a rhythmical series extending all across the well-known B group, having a close resemblance in general character to the series of lines produced by an electric discharge in a vacuum tube of olefiant gas.

The series appears at all temperatures except when a large condenser is employed along with the induction coil, provided hydrogen is present as well as magnesium, while they disappear when hydrogen is excluded, and never appear in dry nitrogen or carbonic oxide.

From their experiments on carbon spectra they conclude with Angstrom and Thalèn that certain of the so-called "carbon bands" are due to some compound of carbon with hydrogen, probably acetylene, and that certain others are due to a compound of carbon with nitrogen, probably cyanogen.

They describe some ultra-violet bands: one of them coincides with the shaded band P of the solar spectrum which accompanies the other violet bands in the flame of cyanogen as well as in the arc and spark between carbon electrodes in the nitrogen. All the bands which they ascribe to a compound of carbon and nitrogen disappear when the discharge is fallen in a non-nitrogenous gas, and they reappear on the introduction of a minute quantity of nitrogen.

They appear in the flame of hydrocyanic acid, or of cyanogen, even when cooled down as much as possible as shown by Watts, or when raised to the highest temperature by burning the cyanogen in nitric oxide; but no flames appear to give these bands unless the burning substance contains nitrogen already united with carbon. As the views of Mr. Lockyer with regard to the multiple spectra of carbon have very recently appeared in the pages of *Nature*, I need only say that these spectra are looked upon as supporting his theory that the different flutings are truly due to carbon, and that they represent the vibrations of different molecular groupings. The matter is one of very great interest as regards the spectra of comets, for the bands ascribed to acetylene occur in the spectra of comets without the bands of nitrogen, showing that either hydro-carbons must exist ready formed in the comets, in which case the temperature need not exceed that of an ordinary flame, or else nitrogen must be absent, as the temperature which would produce acetylene from its elements would also produce cyanogen, if nitrogen were present.

Quite recently, Professors Liveing and Dewar have, simultaneously with Dr. Huggins, described an ultra-violet emission spectrum of water, and have given maps of this spectrum. It is not a little remarkable that by independent methods these observers should have deduced the same numbers for the wave-lengths of the two strong lines at the most refrangible end of this spectrum.

Great atention has been paid by M. Mascart and by M. Cornu to the ultra-violet end of the solar spectrum. M. Mascart was able to fix lines in the solar spectrum as far as the line R (3179), but was stopped by the faintness of the photographic impression. Professor Cornu has extended the spectrum still farther to the limit (2948), beyond which no further effect is produced, owing to complete absorption by the earth's atmosphere. A quartz-reflecting prism was used instead of a heliostat. The curvature of the quartz lens was calculated so as to give minimum aberration for a large field of view. The Iceland spar prism was very carefully cut. A lens of quartz was employed to focus the sun on the slit. Having photographed as far as possible by direct solar light, Professor Cornu compared the solar spectrum directly by means of a fluorescent eye-piece with the spectrum of iron, and then obtained, by photographing, the exact positions of the iron lines which were coincident with observed lines in the solar spectrum. M. Cornu states that the dark absorption lines in the sun and the bright iron lines of the same refrangibility are of the same relative importance or intensity in their

spectra, indicating the equality between the emissive and the absorbing powers of metallic vapours; and he thinks that we may get by the comparison of bright spectra with the sun some rough approximation to the quantity of metallic vapours present in the absorption layers of the sun's atmosphere. He draws attention to the abundance of the magnetic metals—iron, nickel, and magnesium—and to the fact that these substances form the composition of most meteorites. M. Cornu has studied the extent of the ultra-violet end of the spectrum, and finds that it is more extended in winter than in summer, and that, at different elevations, the gain in length of the spectrum for increase of elevation is very slow on account of atmospheric absorption, so that we cannot hope greatly to extend the spectrum by taking elevated observing stations. The limit of the solar spectrum is reached very rapidly, and the spectrum is sharply and completely cut off at about the line U (wave-length 2948). From photographs taken at Viesch, in the valley of the Rhone and at the Riffelberg, 1910 metres above it, M. Cornu finds the limits to be at wave-lengths 2950 and 2930 respectively.

In the actual absorption of bright line spectra by the earth's atmosphere, M. Cornu observed among others three bright lines of aluminium, which M. Soret calls 30, 31, and 32 (wave-lengths about 1988, 1930, and 1860), and he found that 32 could not be seen at the distance of 6 metres; but on using a collimator, and reducing the distance to 1½ metres, the line 32 became visible, notwithstanding the absorption of the extra lens; at 1 metre line 32 was brighter than 31, and at a quarter of a metre 32 was brighter than either 30 or 31. With a tube 4 metres in length between the collimator and prism ray 32 is not seen; but when the tube is exhausted, ray 31 gains in intensity and 32 comes into view, and gradually gets brighter than 31, whilst 30 changes very little during the exhaustion. With the same tube he found no appreciable difference between the absorption by air very carefully dried and by moist air, and concludes that this absorption is not due to the vapour of water, and it follows the law of pressure of the atmosphere which shows it to be due to the whole mass or thickness of the air. Also, M. Soret has shown that water acts very differently on the two ends of the spectrum, distilled water being perfectly transparent for the most refrangible rays, since a column of water of 116 c.m. allowed the ray 2060 in the spectrum of zinc to pass through; on the other hand, water is so opaque to the ultra-red rays that a length of 1 c.m. of it reduces the heat spectra of metals to half their length and one quarter of their intensity.

In concluding my address, I wish to draw attention to some of those magnetic changes which are due to the action of the sun, and which are probably brought about by means of the ether which brings to us his radiant heat and light.

In his discussion of the magnetic effects observed on the earth's surface, General Sabine has shown the existence of diurnal variations due to the magnetic action of the sun; also the magnetic disturbances, aurora and earth currents, which are now again beginning to be large and frequent, have been set down to disturbances in the sun.

Although iron, when raised to incandescence, has its power of attracting a magnet very greatly diminished, we have no proof that it has absolutely no magnetic power left, and with a slight magnetic action the quantity of iron in the sun would be sufficient to account for the diurnal variations of the magnetic needle. During the last few weeks I have been engaged in examining the declination curves for the month of March, 1879, which have been kindly lent to the Kew Committee by the Directors of the Observatories of St. Petersburg, Vienna, Lisbon, Coimbra, and Stonyhurst. Other curves are on their way from more distant stations, but have not yet been examined. On comparing them with the Kew curves for the same period, I find the most remarkable coincidences between the curves from those widely distant stations. It was previously known that there was a similarity between disturbances at different stations, and in one or two cases a comparison between Lisbon and Kew had been made many years ago by Senor Capello and Professor Balfour Stewart, but the actual photographic magnetic records from several stations have never been previously collected, and so the opportunity for such comparisons had not arisen. Allow me, in concluding my address, to draw attention to a few of the more prominent features of these comparisons which I have made. On placing the declination curves over one another, I find that in many cases there is absolute agreement between them, so that the rate of change of magnetic disturbances at widely distant stations like Kew, Vienna, and St. Petersburg is precisely the same; also similar disturbances take place at different stations at the same absolute time. It may be stated generally, for large as well as small disturbances, that the east and west deflections of the declination needle take place at the same time and are of the same character at these widely distant stations.

There are exceptions to this law. Some disturbances occur at one or two stations and are not perceived at another station. Many instances occur where, up to a certain point of time, the disturbances at all the stations are precisely alike, but suddenly at one or two stations the disturbance changes its character: for instance, on comparing Kew and St. Petersburg, we get perfect similarity followed by deflections of the needle, opposite ways at the same instant, and in some such cases the maxima in opposite directions are reached at the same instant, showing that the opposite deflections are produced by the same cause, and that the immediate cause or medium of disturbance in such a case is not far off; probably it is some change of direction or intensity of the earth's magnetism arising from solar action upon it.

Generally, after an hour or two, these differences in the effects of the disturbance vanish, and the disturbances again become alike and simultaneous. In such cases of difference, if the curve tracing of the horizontal or the vertical force be examined, it is generally found that, at the very same instant of absolute time, with the beginning of these opposite movements there was an increase or a diminution in the horizontal force, and that the horizontal force continues to change as long as there is any difference in the character of the declination curves. It is clear, then, from these effects that the cause or causes of magnetic disturbances are in general far distant from the earth's surface, even when those disturbances are large; but that not unfrequently these causes act on magnetic matter nearer to the surface of the earth, and therefore at times between two places of observation, and nearer to one than another, thus producing opposite effects on the declination needle at those places; in in such cases the differences are probably due to changes in the earth's magnetic force. Now, if we imagine the masses of iron, nickel, and magnesium in the sun to retain even a slight degree of magnetic power in their gaseous state—and we know from the researches of Faraday that gases are some of them magnetic—we have a sufficient cause for all our terrestrial magnetic changes, for we know that these masses of metal are ever boiling up from the lower and hotter levels of the sun's atmosphere to the cooler upper regions, where they must again form clouds to throw out their light and heat, and to absorb the light and heat coming from the

hotter lower regions; then they become condensed and are drawn again back towards the body of the sun, so forming those remarkable dark spaces or sun spots by their downrush towards the lower levels.

In these vast changes, which we know from the science of energy must be taking place, but of the vastness of which we can have no conception, we have abundant cause for these magnetic changes which we observe at the same instant at distant points on the surface of the earth, and the same cause acting by induction on the magnetic matter within and on the earth may well produce changes in the magnitude or in the direction of its total magnetic force. These magnetic changes on the earth will influence the declination needles at different places, and will cause them to be deflected; the direction of the deflection must depend on the situation of the earth's magnetic axis or the direction of its motion with regard to the stations where the observations are made. Thus both directly and indirectly we may find in the sun not only the cause of diurnal magnetic variations, but also the cause of these remarkable magnetic changes and disturbances over the surface of the earth.

IMPROVED HELIOGRAPH OR SUN SIGNAL.

By TEMPEST ANDERSON, M.D., B.Sc.

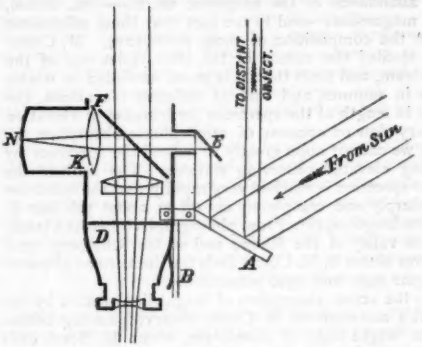
(Read before the British Association, Aug., 1880.)

THE author claims to have contrived a heliograph, or sun telegraph, by which the rays of the sun can be directed on any given point with greater ease and certainty than by those at present in use.

When the sun's rays are reflected at a small plane surface considered as a point, the reflected rays form a cone, whose vertex is at the reflector and whose vertical angle is equal to that subtended by the sun. Adding to the size of the mirror adds other cones of light, whose bounding rays are parallel with those proceeding from other points of the mirror, and only distant from them the same distance as the points on the mirror from which they are reflected. Hence increasing the size of the mirror only adds to the field to which the sun's rays are reflected a diameter equal to the diameter of the mirror, and this at any distance at which the sun-signal would be used is quite inappreciable. Adding to the size of the mirror adds to the number of rays sent to each point, and hence to the brightness of the visible flash, but not to the area over which it is visible.

By the author's plan, an ordinary field-glass is used to find the position of the object to be signalled to, and to it is attached, in the position of the ordinary sunshade, a small and light apparatus, so arranged that when the mirror is turned to direct the cone of rays to any object within the field of view of the glass, an image of the sun appears in the field, at the same time as the image of the distant object, and magnified to the same degree, and the part of the field covered by this image is exactly that part to which the rays are reflected, and at which some part of the sun's disc is visible in the mirror.

A perfectly plane silvered mirror, A, takes up the rays of the sun, and when in proper position reflects them parallel with the axis of D, which is one barrel of an ordinary field-glass. The greater part of the light passes away to the distant object, but some is taken up by the small silvered mirror, E, which is placed at an angle of 45° to the axis of D, and reflected at a right angle through the unsilvered plane mirror, F, and the convex lens, K, by which it is brought to a focus on the white screen, H, which is placed in the principal focus of K. The rays from this image diverge in all directions, and some are taken up by the lens, K, and restored to parallelism; some of these are reflected by



the unsilvered mirror, F, down to the field-glass, D, and if this is focussed for parallel rays, as is the case in looking at distant objects, an image of the sun is seen projected on the same field of view as that of the distant object. As the mirrors, E and F, are adjusted strictly parallel, the rays proceeding from F into the field-glass are parallel and in the opposite direction to those going from the mirror, A to E, which form part of the same pencil as those going to the distant object. Hence the image of the sun seen in the field exactly covers the object to which the sun-flash is visible, and in whatever direction the mirror, A, is moved so as to alter the direction in which rays are reflected to the distant object, and the angle at which part impinge on E and are reflected through the lens, K, the image visible in the glass moves in the same direction. Several attempts to produce this result were made by the use of mirrors and prisms, before the lens, K, was introduced, but they all failed. It was easy to make the image of the sun cover the object when the two occupied the centre of the field of view, but directly the mirror was inclined so as to direct the rays not strictly parallel to the axis of the field-glass, the apparent image diverged generally in the same direction along one co-ordinate, and in the opposite along one at right angles to it, so that nowhere, but in one line across the field, did the image lie in the desired position. The mirrors, E and F, are adjusted parallel once for all, by noticing the position on a screen of the small spot of light reflected from the front of F as the light passes from E to K. The mirrors are moved by the adjusting screws till this spot has, to the bright reflection from the mirror, A, the same relative position that the centre of mirror, F, has to the mirror, A.

In actual use the field-glass is first fixed in position pointing to the object, either by holding steadily in the hand, or better by a clamp attached, by which it can be screwed into a tree or post, or fixed in the muzzle of a rifle. The instrument is turned on the barrel of the glass till the sun is in the plane passing through the two axes of the instrument, and the mirror, A, is turned till the bright image of the sun is seen on the screen, H, through a hole left for the purpose in the side of the tube. On looking through the glass the sun's image is seen, and by then slightly rotating the instrument or moving the mirror, is made to cover the object. The mirror, A, is connected not directly to the body of the

instrument, but to a lever, B, on which it works stiffly, so as to retain any position in which it is placed. Lever B works easily and has a limited range of motion, to one end of which it is pressed by a spring; slight pressure with the finger moves it and its attached mirror, so as to throw the light on and off the object in a succession of long and short flashes by which letters and words may be indicated. Flashes may also be given by moving the instrument if held in the hand.

The above instrument answers well for all positions of the sun except when very low behind the observer's back. For this case another mirror is provided by which the light is reflected on to the mirror, A. Messrs. T. Cooke & Sons, York, are sole makers of this instrument.

AN ACCOUNT OF EXPERIMENTS IN PHOTO-ELECTRICITY.

By G. M. MINCHIN, M.A., Professor of Applied Mathematics in the Royal Indian Engineering College, Coopers Hill.

(Read before the British Association Aug. 1880.)

1. TWO OBJECTS OF PHOTO-ELECTRICITY.—In the study of the electric currents produced in various ways, by the action of light, I have had two objects in view, viz.:—

(I.) *The production at a distance of effects due, in the first instance, to the photographic action of light;* and

(II.) *The continuous daily registration of the intensity of sunlight of any selected wave length.*

It is at the outset evident that for the solution of the latter problem the action of the light, whose intensity is to be measured and registered, must be received on some substance whose chemical composition is either unaltered by the light, or so slowly and slightly altered during the period of observation, that the magnitude of the change may be neglected.

For the solution of the former problem it occurred to me, in the first instance, to receive the photographic action on plates coated with the silver salts in ordinary use among photographers; but I do not now think that it would be necessary to work exclusively with these substances, and if the use of them can be to any extent dispensed with, a corresponding gain would apparently result, since they are permanently and very rapidly decomposed by luminous action.

2. LUMINOUS ACTION A SOURCE OF ELECTRICITY.—It has been long known, from the experiments of Becquerel and Grove, that electrical currents can be produced by the action of light. Becquerel took two clean silver plates, exposed one to the vapour of iodine, plunged both into a cell containing a feebly conducting liquid, and completed the circuit through a galvanometer. The cell being completely covered up, the moment the circuit was completed, a strong current was set up. This current disappeared after about 24 hours. Then, on illuminating the sensitised plate, an intense current was generated by the light.

Grove used a prepared daguerreotype plate inclosed in a box filled with water, having a glass front with a shutter over it. Between this glass and the plate was placed a gridiron of silver wire, and, on completing the circuit through a galvanometer, a current was generated by the action of light on the daguerreotype plate. (See the *Correlation of Physical Forces*.)

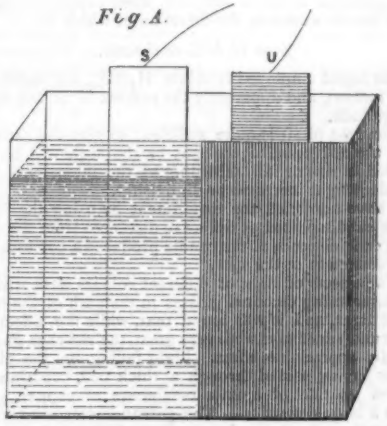
Grove also found that when two clean platinum plates were immersed in a cell containing acidulated water, and one of them was exposed to light, a current was produced. Before the light was allowed to fall on the plate there was, of course, the current which is always produced by the immersion of two plates, however similar we may succeed in making them, in any liquid. This current I shall in the sequel speak of as "the disturbing current," since it is produced by some other agency than that of light; and I shall frequently refer to it as the "D. C." for shortness. The current produced by the action of light on one of the platinum plates was found by Grove to be *always in the same direction as that of the D. C.*; and he found, moreover, that the current produced by blue rays was greater than that produced by red.

Currents of this latter kind may be produced by the agency of light in several different ways. For instance, the two platinum plates will give the current in question if they are immersed in common tap water. Again, the two clean platinum plates may be replaced by two clean silver plates, and we shall obtain still stronger currents by the action of light on one of them. No doubt several other metals would be found to give similar results.

All such currents—viz., those generated by the action of light on any unsensitised metallic plate immersed in a liquid, in presence of a similar plate unexposed to the light—I shall in the sequel designate as "Grove's currents." They are exceedingly small compared with the photo-electric currents with which we shall be occupied.

3. PLATES EMPLOYED.—Since the substances to be acted upon by light were, in my first experiment, salts of silver, I chose silver plates in order to avoid as much irrelevant action in the cells as possible. At first the plates were simply stiff pieces of silver foil, about two or three inches long and one or two inches broad. But it appeared at least possible that much of the current was lost by passing from the coated (or

Fig. A.



sensitised) side of a plate round to the back of the same plate; and for this reason, after having already performed several experiments, I tried the effect of insulating the back and edges of the plate by a thick layer of shellac varnish. The result was a greatly improved action, and this finally led me to fix the silver

foil, by means of pitch, to rectangular pieces of glass. Thus the back of the plate was completely insulated. For the purpose of making the connections, a piece of thin silver wire, about two inches long, may be welded to the upper edge of each strip of silver foil before it is fixed to the glass plate; but binding screws will do, if care is taken to keep the portion of the silver plate which they touch from contact with the liquid in the cell.

Fig. A shows the arrangement of the two plates in the cell. The plate coated with the silver salt, or other substance to be exposed to light, is S. It stands in a rectangular glass cell, in contact with one of its faces: slightly to the side of S, and in contact with the opposite face of the cell, stands the unsensitised plate, U. In the figure we are looking at the back of U; and the whole of the cell, with the exception of the portion directly in front of the sensitised plate, ought to be covered with black paper, to prevent the access of light to the unsensitised plate.

4. NOTATION EMPLOYED.—We shall have such frequent occasion to refer to the sensitised and unsensitised plates—meaning, respectively, the plate coated with the substance to be exposed to light and the plate uncoated—that we shall, for shortness, denote them by the letters S. and U. As already stated, any current produced by agency other than that of light will be denoted by D. C.

5. THE DISTURBING CURRENT.—It may be well to state at once that the D. C. varies, both as to duration and to direction, in an irregular manner, and that Grove's observation, to the effect that its direction is always the same as that of the current generated by light in his experiments, is not true with regard to photo-electric currents generated in other ways.

6. CHLORIDE AND BROMIDE OF SILVER.—If an emulsion is formed by shaking up in a test-tube a little finely powdered chloride of silver mixed with collodion (the test-tube being, of course, completely screened from light by a covering of black paper), a silver plate coated with it in the dark, immersed in presence of an uncoated plate in a cell containing distilled water and a few grains of common salt, will, when exposed to light, give rise to a current, the direction of which is

from U. to S. in the cell.

If the liquid employed is dilute H_2SO_4, the same result follows, and apparently the current is of the same magnitude.

Sunlight (dull) is quite sufficient to give the current, and the deflection of the spot on the scale will be observed to rise or fall according as the intensity of the incident light increases or diminishes.

I have also tried the experiment by using the light of a candle placed at different distances from the cell, and each distance of the candle produced a corresponding deflection of the spot.

The effects of light of different colours were studied by interposing coloured glasses in the path of the incident light, and it was found that, while the effects of blue and violet rays were very great, the red rays gave a hardly appreciable effect. Light falling on the plate, after having passed through a thick cell, containing a dense solution of ammonio-sulphate of copper, gave also a large deflection. The galvanometer used was a Thomson reflecting galvanometer, of about 7,000 units resistance; the screen was usually placed at a distance of about a yard from the mirror; and a piece of burning magnesium ribbon, held at a distance of a foot from the plate, would cause a very rapid motion of the spot off the screen.

The plate may be coated with an emulsion of bromide of silver made in the same way, but I have preferred to use the well-known "Liverpool Emulsion." In this case the liquid in the cell was usually distilled water, with a few grains of bromide of potassium.

The current appears to be of about the same strength as in the case of the chloride cell, and the direction is still *from U. to S. in the cell.*

It is scarcely necessary to say, that chloride and bromide plates must be prepared in a photographic dark room.

I have not systematically kept a note of the direction of the D. C. with these plates, but I have noted some instances at least, in which it is opposite to that of the photo-electric current.

7. IODIDE OF SILVER.—Let a silver plate be coated, in the usual way, with silver iodide, by first pouring a layer of iodised collodion over the plate, and then immersing the latter in a nitrate of silver bath. If the liquid in the cell is distilled water, with a few grains of iodide of potassium, it will be found that the direction of the photo-electric current is,

from S. to U. in the cell,

that is, opposite to the direction of the chloride and bromide currents.

8. SULPHIDE OF SILVER.—It occurred to me that phosphorescence would probably be found to be a means of transforming luminous energy into the energy of electric current. To try this, I coated platinum and silver plates with layers of Balmain's luminous paint (rendered conducting), and then exposed them to sunlight, magnesium light, and candle light, in the usual way. Currents were certainly produced, but with such apparent irregularity that, after about twenty experiments, I abandoned the use of the paint, at least for a while.

In one of these experiments, with a silver plate coated with the paint, I obtained results apparantly so anomalous that I had the plate chemically examined, and Mr. J. W. Clark found that, during the immersion of the plates in the cell, sulphide of silver had been formed. It was evident, then, that sulphide of silver should be specially examined. For this purpose I obtained some in the form of fine powder, shook it up in a test-tube with some pure collodion, and, in a photographic dark room (admitting only red light), coated a silver plate with the emulsion. This plate was immersed, in presence of an uncoated silver plate, in a cell containing distilled water, with a few grains of sulphate of potash.

The connections being made, and the cell kept in the dark, a rather strong D. C. was set up, the direction of this current being *from U. to S. in the cell.*

The light of burning magnesium ribbon, falling on S. through violet, blue, and red glasses, gave a strong current, *which in each case was in the direction opposite to that of the D. C.* Light passing through green glass gave a very small current, also opposed to the D. C.

Thus, the direction of the photo-electric currents is

from S. to U. in the cell,

or opposed to that of the AgCl and AgBr currents.

To give a rough numerical idea of the comparative strengths of the photo-electric currents produced by light falling, through coloured glasses, on an emulsion of sulphide of silver, I quote the records of two experiments:—

June 12, 1880, *Morning.—Magnesium Light.*

Two red glasses in front of S.	Spot moved violently off to left of screen			
One red glass	"	"	"	" "
One green "	"	"	"	about 50 divisions to left.
One blue "	"	"	"	violently off to left.
One violet "	"	"	"	" "

June 12, 1880, *Evening.—Magnesium Light.*

Green glass in front of S.	.	Spot moved 140 divisions to left.
Yellow " " "	.	" off to left.
Red " " "	.	" "
Violet " " "	.	" "
Blue " " "	.	" "
Blue and violet glass in front of S.		" "
Two red " "	"	" "
Red and yellow " "	"	" "
Green and yellow " "	"	" 65 divisions to left.
Green and red " "	"	" " "
No glass, light of a match	. .	" 230 " "

A candle held at varying distances gave deflections varying with the distance, the distance having been varied from about six inches to about five feet.

An experiment was then tried with two clean silver plates immersed in distilled water containing a few grains of sulphate of potash in solution. Results:

Green glass	. . .	12 divisions of scale to left.
Yellow	. . .	15 " " "
Violet	. . .	34 " " "
Blue	. . .	70 " " "

and these currents were *opposed* in direction to the D. C.

I tried, in the Physical Laboratory at South Kensington, the effects of the different parts of the spectrum of the electric light on the sulphide of silver plate, but the intensity of the rays was not sufficient to give appreciable results. Magnesium light, however, falling through coloured glasses, confirmed the results before obtained.

Subsequently, at University College, I used a silver plate on which sulphide of silver had been directly precipitated, without emulsion with collodion, and exposed it in different parts of the spectrum of (not very strong) sunlight. The D. C. had not died out when the light was allowed to fall on the plate. The motions of the spot were not sufficiently marked to allow of any conclusions.

If, therefore, the experiments with coloured glasses can be relied on, it appears that *the rays at both sides of the green, when falling on a plate coated with an emulsion of sulphide of silver, give currents in the same direction, while the green rays themselves produce very little photo electric effect.*

9. NITRATE OF SILVER.—A solution of silver nitrate was mixed in a test-tube with rather thin gelatine, and a silver plate coated with the mixture was immersed, in presence of an uncoated plate, in a cell containing distilled water and a few grains of nitrate of barium. D. C. from U. to S. in cell, rather strong, and of very long duration. Light falling on the plate gave a comparatively small result.

The plate was then further washed over with the silver nitrate solution, and there was an improved result. The cell was connected up with the galvanometer all night; and next day, the spot having come to rest at 250 divisions of the scale from the zero (which was its position when no current passed), magnesium light was used with great effect.

When no glass was interposed, the spot moved a long way off the screen *in the direction opposed to that of the D. C.* With an interposed blue glass the current appeared to be nearly as strong as when no glass intervened. An interposed red glass gave a very small current, indicated by a motion of only 10 divisions, in the opposite direction. From such a small motion, however, no conclusion can be safely drawn, for the current may be only a Grove's current.

10. VARIATION OF THE CURRENT WITH THE DISTANCE.—It was pointed out to me by Professor G. Carey Foster that, other things remaining constant, the photo-electric current might be found to vary inversely as the distance of the luminous source from the sensitised plate. For the energy of the light incident on the plate varies inversely as the square of the distance: *i. e.*, it may be represented by $\frac{k}{r^2}$, where k is a constant and r the distance of the light from the plate. Also, if C = strength of photo-electric current, and R = whole resistance in circuit, the energy of the current is C^2R, so that we have

$$C^2R = \frac{k}{r^2};$$

$$\therefore C \propto \frac{1}{r}.$$

I have not yet verified this by many experiments; but I have had constructed, by Mr. Groves, of Bolsover-street, a large number of small cells, made by fixing two parallel plates of glass in an ebonite frame. These cells can be connected in series, and arranged along circles of varying radii, the incident light being in each case at the centre of the corresponding circle. A few experiments, however, made in this way have roughly agreed with the above law.

11. PHOTOGRAPHIC EFFECT OF CURRENT.—We come now to a point of fundamental importance in photo-electricity—viz., *the effect which the passage of a current through a sensitised plate has on the plate.*

The experiments bearing on this I shall quote in an order the reverse of that in which they were performed.

Two silver plates, both coated with AgBr emulsion (Liverpool Emulsion), were immersed in a tumbler containing water and a few grains of bromide of potassium. One of these plates was connected with the zinc, and the other with the carbon pole of a bichromate cell. The current was allowed to pass for a few seconds, and the result was—

1°. That the plate connected with the carbon pole was (without the employment of a developer) visibly blackened in its immersed part.

2°. That no *visible* change took place on the other plate; but when this plate was "developed" by treatment with the usual pyrogallic acid developer, *its immersed portion was also blackened.*

The effect produced on a sensitised plate by the passage through it of a current generated by light was also investigated, as follows:—

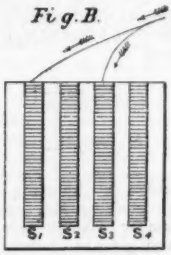
A cell containing distilled water, with a few grains of KBr in solution, was placed in a dark box; two silver plates, S′ and U′, the first coated with Liverpool Emulsion, and the second uncoated, were partially immersed in this cell; outside the box was placed a cell containing water with a little common salt in solution, and in this cell were immersed two silver plates, S and U, the first coated with an emulsion of chloride of silver, and the second uncoated. The plates in the two cells could be connected by means of silver wires which passed through light-tight holes in the side of the dark box. Previous to immersion, however, the bromide plate (in the box) was exposed for ten or twelve seconds to gas-light, the object of this being to assist the photographic action to be produced by the photo-electric current.

The circuit was completed by joining S to U′ and U to S′, and magnesium light was allowed to fall on the chloride of silver plate for some minutes. The bromide plate, S′, was then taken out and developed, and the result was that its immersed portion was very sensibly blacker than its unimmersed portion, the surface of the liquid appearing as a straight line of demarcation across the plate.

The connections were then reversed (fresh plates being, of course, used); S was connected with S′ and U with U′; and again, on development, the immersed portion of the bromide plate, S′, was blackened. It was

of course, necessary to identify the blackening effect with the passage of the current. For this purpose a silver plate, coated with the bromide emulsion, was left

Fig. B.



immersed in a tumbler containing water with a few grains of KBr in solution. After the expiration of some hours (in one instance the time was twenty hours), the plate was developed, but no blackening effect appeared.

12. LOCALISATION OF THE EFFECT.—For the solution of the problem of photo-electric transmission, it is evident that something more is necessary than the proof that the developable photographic effect is limited to that portion of the plate which is immersed in the conducting liquid. The effect must be still further localised in a conclusive manner.

For this purpose I fixed several strips of silver foil, s_1, s_2, s_3, s_4 (fig. B), on a glass plate; two or more of these strips were thrown into the circuit, the others being left out, while the whole plate was uniformly coated with Liverpool Emulsion, and immersed in a cell placed in the dark box, the liquid extending about half-way up the strips. The plate was connected with the carbon pole of a bichromate cell; and when it was removed from the cell, the blackening took place only on those strips which were metallically thrown into the circuit, *and only on the immersed portions of these strips.* One of these plates, containing two strips, was shown at a recent meeting of the Physical Society.

(To be continued.)

THEILER'S PATENT TELEPHONE TRANSMITTER.

FIG. 1 represents the outside appearance of the instrument, the dimensions of which are only 5 in. by 6 in. by 1½ in., so that the whole apparatus, containing induction coil, microphone, automatic switch and bell push, is of very small bulk. The transmitter may either be screwed or hung against a wall like a picture, and as its appearance is by no means clumsy or awkward the instrument may be fitted up in a drawing-room without disfiguring its surroundings.

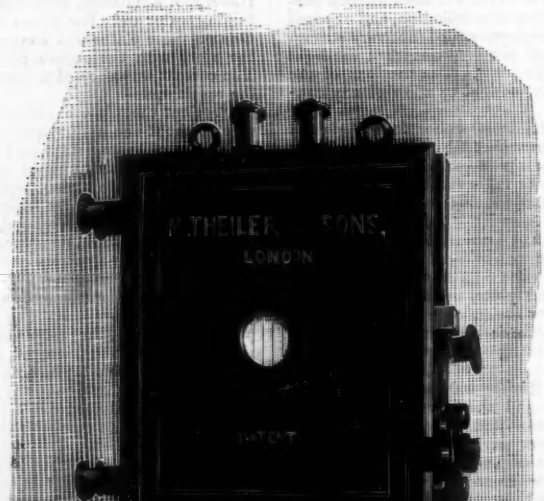


FIG. 1.

There being no adjustment of any kind, variation of temperature, &c., cannot disturb the position of its component parts.

The funnel which is required for speaking into with other transmitters is entirely dispensed with in the new transmitter. The use of such a funnel, particularly in those transmitters which require rather loud and close speaking, is not free from objection.

Figs. 2 and 3 represent the inside of the transmitter, and show the peculiar form of microphone which, after innumerable experiments with every other possible form, was found to be the best.

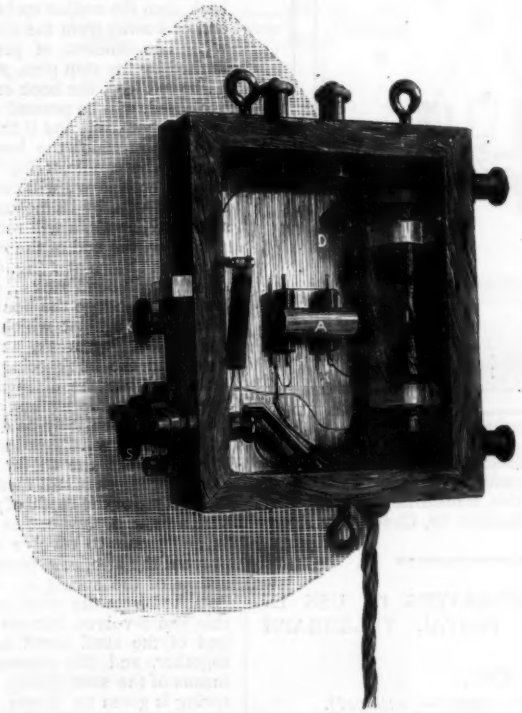


FIG. 2.

D is a diaphragm of Swiss pine wood or of cork. The former substance makes a highly sensitive diaphragm, while the latter is more remarkable for the great distinctness of articulation produced.

To this diaphragm two cylindrical pieces of any conducting substance, B B (fig. 3), are cemented in a parallel line, and a connection is made from these cylinders to the battery and primary circuit of an induction coil, I I, in the usual way. The circuit is closed by the rod, A (which is also cylindrical), suspended on a silk thread from the diaphragm at an angle of about 25 degrees. The nearer this suspension approaches to the perpendicular the more sensitive the transmitter becomes, but as extreme sensitiveness also includes the transmission of any, even the feeblest, noise, and imparts to the articulation a peculiar metallic twang, it was avoided by suspending the rod, C, at an angle of 25 degrees.

It will be seen that the incidence of the suspended contact piece with the fixed ones forms mathematically four sharp points, which are, however, free from the great liability to breakage or wasting away which *actual* sharp points would possess.

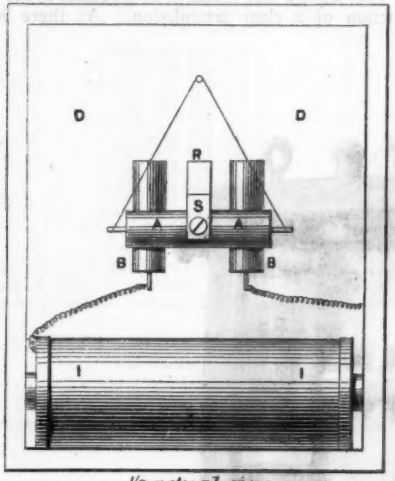
This feature was found to be essential to the production of a clear articulation. As there is no friction of surfaces in this arrangement, that grating rasping articulation so peculiar to common microphones is totally absent in this transmitter.

The contacts, as well as the points of suspension, being all on the diaphragm itself, it does not at all matter whether the tension of the latter be altered by change of temperature, &c., or not. If the fixed contacts should, from any such cause, change their position, the suspended contact would follow them, and their relative position would practically not be altered.

If the diaphragm is vibrated very violently (by shouting against it), the suspended piece, C, would separate from B B altogether, and produce a harsh sound in the receiver. This can be entirely prevented by the stop, S (fig. 3), which is adjustable in the bridge, R, and does not allow the piece, C, to separate from B B entirely. It is not as immaterial as is generally believed, or has been asserted, what kind of battery is used with a microphone transmitter. On the contrary, the results obtained will

differ with each change of battery; that is to say, no two cells, even of the same size and description, will give *exactly* the same results. The Leclanché

Fig. 3.



½ actual size.

is said to be the least reliable battery for this purpose, while the "Bichromate" acts very well indeed.

We may add that this transmitter can be seen working at Messrs. Theiler's, 86, Canonbury Road, daily.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XVII.

THE A B C INSTRUMENT—(*continued*).

The Communicator.

IN the last article the method by which the magneto currents for working the A B C Instrument were *generated*, was explained; the mechanism by means of which these currents are *controlled* is of a highly ingenious and perfect nature.

Referring to fig. 67, it will be seen that the wheel, W, which (as was explained in the last article) is geared to the revolving armature of the magneto-current generator, is turned by the handle, H. On the axle on which H and W are fixed is also attached a bevil wheel, *f*. This wheel gears into a larger bevil wheel, F, the upper portion of which is also seen in fig. 68.

To the wheel, F, is attached a second wheel, W_1, seen in figs. 68 and 69; in fact, W_1 and F are formed of one piece of metal.

Now, on turning the handle, H, it is evident that the wheel, W_1, will be turned in unison with it.

The wheels, W_1 and F, turn loose on a steel axle, *d*. To this axle, and at right angles to it, is fixed the brass arm, *a*, *a*, and also the iron boss, B (fig. 68). On a small piece projecting from B are secured two steel springs, *s* and s_1. The ends of *s*, s_1, are turned down, as seen in fig. 70, and between these ends is the tail-piece, t_1, of the hook, *h*. This hook hinges on a screw fixed in the arm, *a*, *a*, as can be seen in figs. 68 and 69.

The strength of the spring, s_1, is greater than that of the spring, *s*, so that the former tends to push the hook end of *h* against the circumference of the wheel, W_1. If, however, the spring, s_1, be pulled back, then the weaker spring, *s*, would press the hook end of *h* away from the circumference of the wheel, W_1. The amount of play which *h* can have is limited by the stop pins, p, p_1. Now, if the spring, s_1, be left free, the hook end of *h*, as has just been explained, will be pressed against the circumference of the wheel, W_1, and if the latter be rotated in the direction in which the hands of a watch turn, by turning the handle, H (fig. 67), then one of the projecting teeth in W_1 will catch against the hook end of *h*, and will, by its means pull round the arm, *a*, *a*, so that W_1 and *a*, *a* will rotate as one piece.

If, now, the end of the spring, s_1, which is bent round, as shown at *t* (fig. 69), comes against an obstacle, it will bend back s_1, and then the spring, *s*, will tend to disengage the hook, *h*, from the tooth of the wheel, W_1, against which it is hitched. But the spring, *s*, being weak, and the grip between the tooth and the hook being considerable, the latter would not become disengaged, unless the tail-end, t_1, of *h* also came against an obstacle. In this case *h* would immediately be disengaged from the tooth of the wheel, W_1. But immediately *h* becomes disengaged from the tooth, the spring, *s*, comes into play, and forces it still further back, thus setting it quite clear of the teeth of the revolving wheel, W_1. The arm, *a*, *a*, thus comes to rest, whilst the wheel, W_1, continues to revolve unimpeded. In order to prevent the arm, *a*, *a*, from being forced back by the action of the spring, s_1, when the hook becomes detached from the tooth of W_1, the inner end of this arm revolves, friction tight, against the inner end of the steel lever, A, the two being pressed together, and the necessary friction produced by means of the steel spring, S. The tension of this spring is given by means of the boss, *b*, which is slipped over the axle, *d*, and pressed down on the spring, S, and then fixed by a screw. The arm, A, being immovable (except between very small limits), the friction between it and the arm, *a*, *a*, keeps the latter held with a considerable degree of firmness in the position which it has reached at the moment when the hook of *h* disengages itself from the tooth of W_1. Thus, the spring, s_1, being unable to force the arm back, remains itself held back by the obstacle against which it, and also the tail-piece, t_1, have pressed. And therefore the spring, *s*, is able to exert its full force in clearing the hook, *h*, from the teeth of the revolving wheel, W_1.

If, now, the obstacle referred to be removed, the spring, s_1, being no longer held back, forces the hook, *h*, forward, and immediately one of the teeth of the revolving wheel, W_1, hitches against it, and the arm, *a*, *a*, is carried round as at first.

The obstacles against which the end of the spring, s_1, and the tail-piece, t_1, of the hook, *h*, can catch are the keys arranged around the circumference of the dial of the communicator. These keys are of the form shown by fig. 70. They are movable about the point, *i*; there is no hinge or pivot at *i*, but the long tail-piece, *i o*, is slipped down in a small slot,

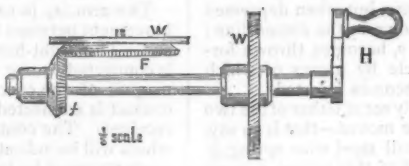


FIG. 67.

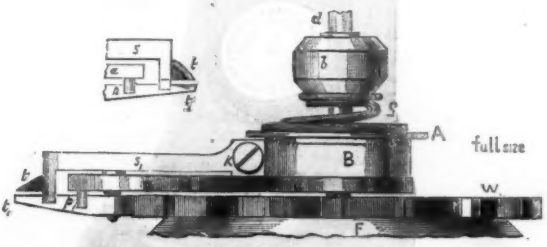


FIG. 68.

FIG. 70.

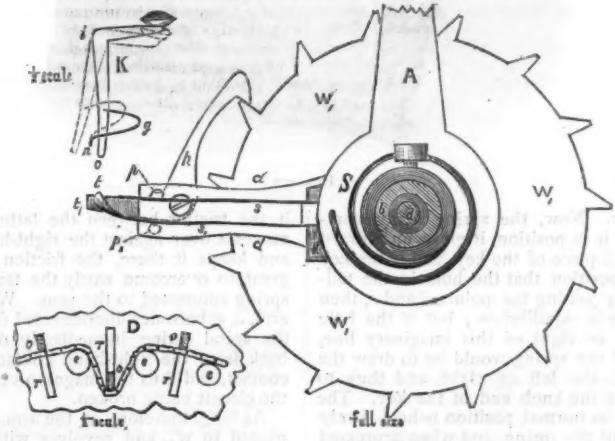


FIG. 69.

FIG. 71.

and then a brass plate is screwed down over at the point, *i*; the fitting at the angle being rather loose the key can rock to a certain extent, and thus the effect of a hinge is obtained without pivots.

In their normal condition the keys are in the position indicated in the figure, but when depressed they take up the position shown by the dotted line; in other words, the tail-end, *o*, becomes thrown forward, and forms the obstacle by means of which the motion of the arm, *a*, becomes arrested.

In order to keep a key firmly set at either of the two positions to which it may be moved—that is to say, either up or down—the small steel wire spring, *g*, is provided. The lower end of this spring, *n*, is set in a hole in one of the brass foundation plates of the instrument, and the other end is bent round at right angles and fits in a small hole in the tail-piece of the key. Now, the spring being compressed in setting it in position, it gives an upward pressure to the tail-piece of the key, and if the key were in such a position that the hole in the tail-piece lay on a line joining the points, *i* and *o*, then the key would be in equilibrium; but if the hole were to the left or right of this imaginary line, then the action of the spring would be to draw the tail-piece over to the left or right, and thus to elevate or depress the knob end of the key. The key, therefore, in its normal position is held firmly up by the action of the spring, and when depressed is held firmly down.

When any key is depressed the one which was previously pressed down becomes immediately raised again; this is accomplished by making the tail-ends of the keys press against an endless chain which passes round small brass pulleys set between each of the tail-ends, as seen in fig. 71; the length of slack in the chain corresponds to the length of movement of any one key as seen in fig. 70. The tail-ends, *o o*, move in slots, *r*, cut in the base plate, D.

The arm, A, is capable of a very slight angular movement between two contact points at its extreme end. The right-hand one of these contact points is connected to one end of the coils of the electro-magnet of the current generator, and the left-hand contact is connected to one end of the coils of the receiver. The contacts are arranged in a manner, which will be indicated in the next article, so that one contact cannot be broken before the other is made.

The arm, A, is normally drawn to the left by a small spiral spring.

On turning the wheel, W_1, and the arm, *a a*, with it, the friction between the latter and the arm, A, moves A over against the right-hand contact point and keeps it there, the friction being sufficiently great to overcome easily the tension of the spiral spring connected to the arm. When, however, the arm, *a, a*, becomes disconnected from the wheel, W_1, the spiral spring immediately draws the arm, A, back from the right-hand contact to the left-hand contact, and thus the magneto currents are cut off, the circuit being broken.

As long, therefore, as the arm, *a, a*, remains connected to W_1, and revolves with it, the magneto currents can flow, but immediately the arm, *a a*, becomes disconnected from W, through the mechanism of the former coming against a depressed key, the currents are cut off, although the armature of the current generator continues to revolve.

FIG. 72.

GILBERT'S NEW TELEGRAPH WIRE BINDER.

THE main objects of this Wire Binder, the invention of Mr. Gilbert, of the Dundee and Arbroath Joint Railway, are:—

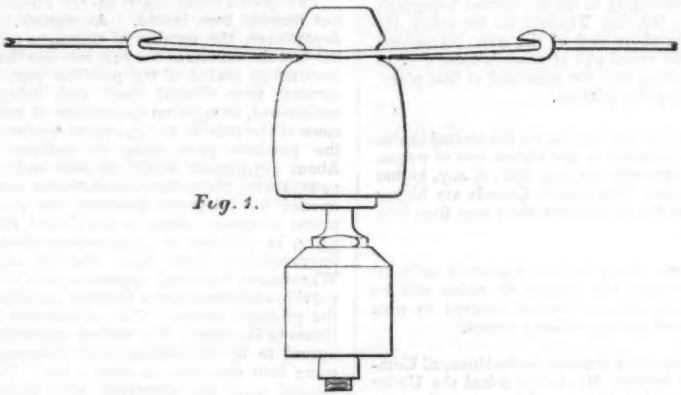


Fig. 1.

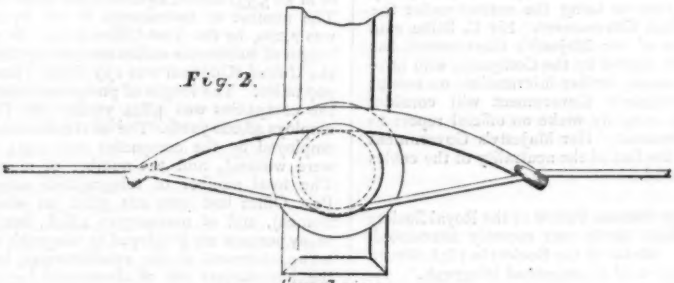


Fig. 2.

½ real size.

1st. To facilitate the erection and taking down of telegraph wires.

2nd. To reduce friction at the insulators, and the consequent breakages of the wires which occur with the ordinary wire binder.

3rd. To reduce surface contact of wires with insulators, and thereby to diminish the leakage of current in damp weather.

As will be seen from figs. 1 and 2, which represent respectively the elevation and plan of an insulator with the new binder attached, the latter is of a bow shape. It is constructed of malleable iron, and has its free ends hooked so as to embrace or grip the wire some inches on each side of the insulator. It can be applied to any insulator having a side groove, and by the most inexperienced workman in a few seconds.

Notes.

A CINCINNATI company is negotiating with the cable companies for the lease of a line for eight days, for the purpose of testing experiments for telephonic communication with Europe. It is believed that the new French line will be secured. The arrangements, it is thought, will be completed in a few days. The process upon which the proposed work is to be done is based upon the Orangbough invention of 1868 and the recent Klemm patents. The tests will be made from New York city. Only the combination of the two sys-

tems mentioned will be tested, to the exclusion of the Bell, the Edison, or any of the instruments now in active use, as the new company claim that they are actually infringing.

A DISCUSSION, which has been carried on with considerable animation for several weeks in the Edinburgh daily newspapers, on the dangers of telephone wires, has just been closed. The opinion is gaining ground that sooner or later the wires must come down.

THE S.S. *Dacia*, belonging to the Silvertown Telegraph Works Company, left the Thames on Saturday for Algiers, to lay the shore end of the new Marseilles-Algiers cable. The vessel will afterwards cross over to Marseilles, and, having laid the shore end at that place, will pay out the deep-sea portion.

CANADIAN operators are leaving for the United States in large numbers, tempted by the higher rate of wages, and the fact that expenses are but little, if any, higher than in the Dominion. Salaries in Canada are higher at the present time for strictly first-class men than they ever were before.

EXPERIMENTS are being tried at Plymouth with an electrical range-finder, the results of which will be known very shortly, and are looked forward to with considerable interest among military circles.

TELEGRAPH CABLES IN PERU.—In the House of Commons on the 7th instant, Mr. Caine asked the Under Secretary of State for Foreign Affairs whether the attention of the Government had been called to the cutting, by the Chilian authorities, of the submarine telegraphic cables laid by the West Coast of America Telegraph Company on the coast of Peru, the neutrality of which cables had been declared; and whether any steps had been taken to bring the matter under the notice of the Chilian Government. Sir C. Dilke said that the attention of her Majesty's Government has been called to this matter by the Company, who have been requested to supply further information, on receipt of which her Majesty's Government will consider whether they can properly make an official report to the Chilian Government. Her Majesty's Government will inquire as to the fact of the neutrality of the cables having been declared.

THE late Mungo Ponton, Fellow of the Royal Society of Edinburgh, whose death was recently announced, obtained the Silver Medal of the Society in 1838, for "a model and description of an improved telegraph."

AMONGST the grants of money appropriated to scientific purposes by the general committee of the British Association, are the following:—Professor Carey Foster, Electrical Standards, £100; Dr. O. Lodge, High Insulation Key, £5; Mr. J. M. Thomson, Inductive Capacity of Crystals and Paraffins, £10.

IN the place of the ordinary sulphuric acid solution, M. Agassis charges the zinc cell of a Bunsen battery with a solution composed of about 15 per cent. of potassic cyanide, potassic hydrate, or ordinary sal ammoniac, in water. With either of these solutions the zincs do not require to be amalgamated, and the constancy of the current is increased.

MR. D'ARSONVAL has effected an improvement in the ordinary gravity Daniell, by which the local action on the zinc due to the diffusion of the sulphate of copper in the cell is entirely prevented. This end is arrived at by placing a layer of animal charcoal over the sulphate of copper crystals, which effectually prevents the solution of the latter from passing into the sulphate of zinc solution, in which the zinc element is immersed. A somewhat similar device was invented by Mr. C. F. Varley several years ago; the protecting diaphragm in this case being oxide of zinc. The use of such separators, however, increases considerably the resistance of the batteries.

THE 26th annual report of the Postmaster-General has recently been issued. As regards the telegraphic department, the number of messages received during the first six months of the year was less than in the corresponding period of the previous year, but a marked increase then showed itself, and, being more than maintained, brought up the number of messages at the close of the year to 26,547,137, as against 24,459,775 in the previous year, being an increase of 2,087,362. About 313,500,000 words of news were delivered to newspapers, clubs, &c.; seventy-one new offices were opened for telegraph business, the total number of postal telegraph offices in the United Kingdom being 3,924, in addition to 1,407 railway stations. Various improvements have been effected, notably in the Wheatstone receiving apparatus, and it is proposed to provide additional wires between London and many of the principal towns. The private wire business continues to increase. The revised regulations and tariffs agreed to by the International Telegraph Conference came into operation on April 1 last. Ten years have elapsed since the telegraphs were transferred to the State, and from the particulars given it appears that, whereas the telegraph companies had at the time of the transfer 1,992 offices in addition to 496 railway offices, the Post Office can boast of 3,924 offices of its own and 1,407 railway stations open for telegraph work, or in all 5,331 offices, against 2,488 under the companies. The number of instruments in use by the companies was 2,200, by the Post Office 8,151. In 1869 the total length of submarine cables connecting different parts of the United Kingdom was 139 miles. Last year it was 707 miles. The length of pneumatic tube employed by the companies was 4,844 yards; the Post Office now employs 48,260 yards. The total number of telegraphists employed by the companies was 2,514 (of whom 479 were women), and the number of messengers 1,471. The total number of telegraphists employed by the Post Office last year was 5,611 (of whom 1,556 were women), and of messengers 4,648; but, besides these, many persons are employed in telegraph work who hold no appointment on the establishment, but are paid by the postmasters out of allowances for assistance. In 1869, about 6,500,000 messages were forwarded by the telegraph companies and railway companies transacting public telegraph business. Last year the Post Office forwarded 26,547,137 messages, or four times as many as in 1869.

THE Belgian State telegraph system employs 1,193 Morse, 52 Hughes, and 9 Breguet instruments on its lines, the length of the wire for the latter being nearly 14,000 miles.

SEVERAL tenders have been sent in for lighting the City streets, some of those firms tendering desiring only to secure a portion of the whole contract. The matter will be decided in open Court, which sits fortnightly. It is doubtful, however, if it can be considered at the next sitting; the following one will probably be the one selected for discussion of the subject. We believe there is a desire on the part of the authori-

ties to divide the contract amongst several firms and systems, so as to ascertain the best kind of light for the purpose; but this division can easily be carried too far. It seems to us that there are very few firms at present in a position to undertake the work.

AT the British Association Meeting at Swansea, the Compagnie Générale d'Eclairage Electrique of Paris, a Company which has recently been formed with a capital of 8,000,000 francs, exhibited for the first time in this county the Jamin patent system of electric lighting, the invention of Professor Jamin, Member of the Academy of Sciences of France. The light was shown in operation, eighteen lamps, inclosed in globes of various descriptions, and suspended from the roof, being used for illuminating the immense room in which the exhibition and soirées are held, and the dimensions of which are 180 feet long by 140 feet wide. These eighteen lamps were mounted in three different circuits of six lights each, and six more lamps, mounted in a fourth circuit, were distributed as follows:—

2 lamps at Mr. George Heard's saw mills, situated at a distance of about 250 yards from the Exhibition Pavilion.

2 lamps on a stall, where the various appliances used in connection with the Jamin's system, and the lamp itself, were exhibited and demonstrated by Mr. J. A. Berly, C.E., A.S.T.E., the representative and engineer in this country of the Compagnie Générale d'Eclairage Electrique, and under whose immediate supervision the whole of the plant for electric lighting was erected and fixed.

1 lamp over the principal entrance.

1 lamp outside the pavilion, lighting the approaches leading to the main entrance.

The electric current was generated by two self-exciting Gramme dynamo-electric machines, capable of feeding from 4 to 16 lights each, but arranged for 12 each. The said Gramme machines were driven by the steam engine of Mr. G. Heard's saw mill, and who kindly lent the steam-power for this occasion, as well as the use of his premises and staff. The engine was an horizontal single cylinder of 20 horse-power, and manufactured by the firm of Charles Powis, of Millwall, London. A description of the Jamin Lamp has already appeared in the No. of the *Journal* for July 1st.

THE 16th annual report of the New Zealand Telegraph Department has recently been issued. The report states that the revenue for the year was estimated at £80,000. For the nine months ended the 31st March it amounts to £53,914 13s. 5d. The gross earnings of the department for the year ended 30th June, 1879, were £112,328 13s. 9d. The total number of messages of all codes transmitted during the nine months of the year was 1,008,409, being a proportional decrease, in comparison with the previous year, of 188,432. Comparing the number of telegrams transmitted during the nine months with the letters posted during the same period, 14·27 telegrams were sent for every 100 letters. The proportion last year was 19·64. The number of money-order telegrams sent during the nine months was 11,291, representing a value of £46,425 5s., showing a slight proportional decrease in comparison with the preceding year, both in messages and value. The commission collected by the Post Office on these transactions amounts to £1,338 3s. 9d., and, after deducting the fees due to this department for telegrams, amounting to £564 11s., leaves to the credit of the Post Office £773 12s. 9d., which is equal to 1·66 per cent. on the amount transmitted. The "Urgent" and "Delayed" codes continue to increase in public favour. The former is taken great advantage of during business hours by the commercial branch of the community, while the latter is made a circulating medium for advices by travellers and trade representatives to their constituents, and for other matters where a night's delay is of no importance.

A JOURNAL devoted to telephonic interests, and called the "Telephonic Exchange Reporter," has been started in Cincinnati.

MR. BELL, of telephone distinction, is described as 32 years old. It is added that he "received a large sum for his invention, besides shares in the company, and a salary of 25,000 dols. a year as electrician. His father-in-law, Mr. Hubbard, of Boston, sold his property and embarked money in the telephone, and deserves the chief credit as the business spirit of the invention. He has made a million or two out of it, and is now in London, where a number of prominent English associates will join in companies for Egypt, India, China, and Japan."

WE have been requested to notify that, at the University of London, in the engineering department, an examination will be held on September 28th and following days, for two entrance scholarships of the value of £35 per annum, and tenable for two years. These scholarships, given by the Gilchrist trustees, are now offered for competition for the first time. Candidates must be not more than 18 years of age on the 1st October immediately succeeding the examination, and notice must be sent to the secretary of the intention to compete before the 23rd September. Besides the foregoing, a senior scholarship, of the value of £80 (half payable at the time of the award and half in the succeeding June), will, during the pleasure of the Gilchrist trustees, be awarded at the close of each session from 1881-82 inclusive.

A NEW system of fishing with a line has been invented by a German. This invention, which was exhibited at the Berlin Fishery Exhibition, excited considerable curiosity; it consists of a small skiff, which can be directed without noise to any point in the water by means of a wheel apparatus worked by a magnet. When the boat has arrived at the required place it anchors itself, whilst the line, with the hook attached, drops into the water. The little skiff contains a battery and an electro-magnet, which are so arranged that the slightest bite made by the fish closes the circuit. Immediately, with the rapidity of lightning, by means of an electro-magnet, the line, hook, and fish are jerked up, and a small bell warns the fisherman that the fish is caught.

THE Atlantic cable recently laid was completed in twelve days after the starting of the expedition from Heart's Content, Valentia.

THE eminent publishers, Messrs. W. & A. K. Johnston, are executing a series of wall-drawings on Magnetism, Frictional and Voltaic Electricity, and Telegraphy, under the direction of Mr. William Lees, M.A., Lecturer on Natural Philosophy, Edinburgh. We believe Mr. Lees is preparing a little handbook to be used with the diagrams.

EXTENSION OF THE TELEPHONE SYSTEM.—The United Telephone Company have begun to erect a wire between Dundee and Forfar. It is to be carried along by the side of the highway, and the work is expected to be completed in the course of a few weeks. The Company contemplate an extension of their wires at no distant date to Blairgowrie, Perth, Arbroath, Montrose, and other towns in the district.

New Patents—1880.

3473. "Apparatus for transmitting and receiving signals by means of electricity." A. F. ST. GEORGE. Dated August 27.

3494. "Improvements in electric lamps, in the manufacture of parts thereof, and in apparatus for exhausting them, the exhausting apparatus being also applicable to other purposes." ST. G. L. FOX. Dated August 28.

3496. "Apparatus for obtaining electricity." C. W. HARRISON. Dated August 28.

3505. "Electric signalling telegraphs and visual indicators for use thereof." W. CLARK. (Communicated by J. Van D. Reed.) Dated August 28.

3509. "Electric lamps." J. HOPKINSON. Dated August 30.

3564. "Compensating apparatus for the contraction and expansion of signal wires." C. GAUNT. Dated September 2.

3637. "Improvements in the art and means of lighting cities by electricity." P. M. JUSTICE. (Communicated by H. C. Spalding.) Dated September 7.

3670. "An improved process of regenerating the fluids of galvanic batteries in which caustic alkalies are employed, and of recovering the zinc hydrate from solution." A. M. CLARKE. (Communicated by E. Reynier.) Dated September 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

5206. "Electric lamps." G. G. ANDRÉ. Dated December 19. 6d. According to this invention the arrangement of parts, as described in former patent of March 1st, 1879, is reversed, so far that the base or bed plate is placed at the top, and the inclosing glass cylinder is made short and shallow, and is attached air-tight to the bottom of the plate. To gain the necessary height for the carbon or carbons, the inclosing tube for same is carried up through and beyond the plate, and it is inclosed in an outer larger metal tube or casing which is fixed air-tight to the plate, and is closed air-tight at the top by a removable lid. The commutating magnets when used are placed by preference on the top of the plate and outside the just named metal casing. The lower or negative electrode is carried down from the plate and may be of metal. By the employment of the short glass cylinder and the upper metal casing, as large and effective a cooling surface is obtained as is needed for keeping down the temperature of the inclosed atmosphere without using a large glass cylinder, and the replacement of the carbon or carbons is facilitated without breaking the joint between the glass cylinder and the plate by simply removing the small lid on the top of the metal casing, or the casing may be made permanently closed at the top, but it would then have to be made removable from the plate, or the joint to be broken may be in any other part of the casing. Also the invention consists of an improved arrangement of commutator for electric lamps. In order to reduce the electrical resistance of the coil of the electro-magnet, and to weaken its hold on the armature while the lamp is burning, part of the current is shunted after the armature is attracted by the armature coming against a stop or pillar, around which is placed a coil so proportioned as to take away from the magnet the requisite part of the current.

5335. "Telephones." ARNOLD WHITE. Dated December 31. 6d. (A communication from T. A. Edison.) Relates to improvements in and connected with the receiving apparatus of telephones. Patents No. 2909, 1877, and 2396, 1878. It proposes to dispense with the chemical substance previously employed with the chalk, and to use the latter alone moistened with distilled or pure water. It is also proposed to employ a metal spring or arm tipped with palladium, whereby the degree of frictional variation is increased under the action of a given strength of electric current, and a corresponding augmentation in the volume of sound is obtained. Likewise it is found advantageous to place the receiving apparatus in a tertiary circuit in lieu of the secondary circuit, a special key being of necessity used in the primary circuit when it is so placed, so as to obtain the full effect of the current from the distant station on the receiving apparatus. The tertiary circuit is opened prior to the closing of the primary circuit, so as to obviate the powerful inductive discharge directed on the receiving apparatus, which discharge has a deteriorating effect upon the surface of the chalk body of the receiving apparatus.

5337. "Automatic switches for telephones." A. M. CLARK. (A communication from E. T. Greenfield and D. McLean Adee, of Brooklyn.) Dated December 31. 6d. The object is to provide for an automatic switch, a movable electric or magnetic conductor that by its own gravity shall make or break magnetic and electric connection. It consists in a movable electric or magnetic conductor formed of quicksilver, metallic sand, or shot, or the like placed in a tube or cylinder of metal, glass, rubber, or other material, but preferably of metal that is fitted with electrical connections, so that a change in the position of the said tube or cylinder shall cause the quicksilver, metallic shot, or other conductor moving by its own gravity to make or break contact or connection between the electrodes.

1880.

3. "Combined fire alarm and fire extinguisher." W. SIMPSON. Dated January 3. 2d. Consists of a water chamber and an alarm. The firing of a cartridge cuts an electrical circuit, releasing the water from the former and setting in action the latter. *(Provisional only.)*

5. "Magnetic curative appliances." F. BAPTY. Dated January 1. 2d. Consists in bending the magnets to conform to the various parts of the body, and also in subjecting their surfaces to Baiff's protective process. *(Provisional only.)*

18. "Electric lamps." J. W. SWAN. Dated January 2. 2d. Consists in a method of obtaining a higher vacuum with incandescent lamps than has been hitherto obtained, and is effected in the following manner: after the air has been exhausted as far as possible in the well-known manner, a current of electricity is passed through the carbon so as to render it incandescent, during which incandescence the exhaustion is carried still further, until the residue of air is so small as practically not to affect the durability of the carbon.

33. "Developing electric currents for electric lights." T. ALVA EDISON. Dated January 3. 4d. Consists in a method of regulating and controlling the action of magneto-electric generators, and governing the electromotive force throughout a system of conductors, in which system are included electric lamps or magneto-electric motors.

71. "Signalling, &c., on railways." ST. JOHN V. DAY. (A communication from abroad by J. S. Williams, of Riverton, New Jersey.) Dated January 7. 2d. In

constructing apparatus to operate and govern the working and position of switches, crossings, and signals through the medium of electricity and explosive materials; the igniting or exploding in a receiver is caused to create a vacuum, and thereby cause the switch, signal, or other movable parts to be moved. *(Void.)*

75. "Dividing and regulating the electric light." A. M. CLARK. (A communication from Louis Roguier of Paris.) Dated January 7. 8d. The object of this invention is to obviate defects in existing systems, by placing in the principal circuit the part of the apparatus to be influenced by the current (as in regulators working on independent circuits), and in derivation, a resistance formed of a stick of plumbago, a platinum wire, or even a column of liquid, but preferably a carbon of small diameter and high resistance, forming a sort of auxiliary circuit. Also in a mechanical arrangement for maintaining the length of the arc constant.

79. "Producing and utilising electric currents." R. WERDERMANN. January 8. 6d. Consists of a magneto or dynamo-electric machine, the bobbin composed of a series of helices or coils, each of which is constructed and arranged to constitute an open circuit; of a series of conductors arranged in such a manner as to constitute a disc, in a bobbin; the combination of the said series of helices, each of which constitutes an open circuit, with the said conductors arranged on one or both sides of the bobbin. The brush or conducting rubber constructed and arranged in combination with the conductors. Also in the employment for lighting purposes in an electric circuit, of apparatus wherein gases are rendered luminous by silent or obscure discharges of electricity; and in an improved apparatus, whereby gases are rendered luminous by frictional electricity.

91. "Microphonic and telephonic apparatus." W. R. LAKE. (A communication from Emile Berliner, of Boston, U.S.A.) Dated January 8. 8d. Relates to improvements in microphones or contact telephones. The claims are sixteen in number.

158. "Telephonic and microphonic apparatus." L. J. CROSSLEY. Dated January 14. 6d. Consists in the construction and employment of an improved electro-magnetic telephone receiver, combining a number of armatures or receivers which convey the sound or sounds from each receiver to a common centre or ear tube; also in the method of connecting an electro-magnetic telephone receiver and transmitter with an induction coil or coils, whereby the primary and secondary currents from such coils, or the secondary currents alone, are utilised.

203. "Developing electric light." J. CLARK. Dated January 16. 2d. To provide a simpler compound of asbestos for forming the burner of electric lamps than the burner described in patent of October 9th, 1878, and in inclosing the improved burner in a surrounding globe filled with carbonic acid gas or water. *(Provisional only.)*

231. "Submarine electric lanterns." F. W. HEINKE and G. LANG. Dated January 19. 2d. Relates to a method for hermetically sealing the cylinders containing the light, and thus making them watertight. *(Provisional only.)*

250. "Electric lamps." J. W. SWAN. Dated January 20. 6d. Relates to that class of lamp in which light is produced by the incandescence of a conductor of carbon in an exhausted glass bulb, and consists in the use of caps of platinum fused to the glass of the lamp as a means of preventing the fracture of the glass by the heating of the conducting wire. In the method of forming the carbons of paper, or card bent to the required form. In forming the carbon by carbonising vegetable parchment. In employing several carbon arches in each lamp, and in preventing the evolution of gas occluded by the conducting wires within the lamp, by coating them with glass or enamel.

296. "Electric telegraphs." W. C. BARNEY. Dated January 23. 8d. Has for its object to increase the rapidity with which messages may be transmitted through long lines of electric telegraphs, and more especially through submerged cables and subterranean lines, by diminishing induction: 1st, by the use of a current of low tension; 2nd, by working under the influence of a current taken at an epoch more or less of its variable state; 3rd, by keeping the cable always in communication with the earth near to both ends.

303. "Telephone signal apparatus." W. M. BROWN. (Communicated by G. H. Bliss, of Pittsfield, Mass. U. S. A.) Dated January 23. 8d. Relates to a method of operating telephone calls, and consists in an armature-controlling device, operated by a clock or time-train, to render the signal bell of each telephone of a circuit inoperative, except at a certain moment; the moment or exact time for operating each signal bell in the circuit being different at each telephone in the circuit, and being known at the central office, so that by breaking the circuit from the central office at the proper moment, the signal for any telephone or instrument in a circuit may be operated without disturbing any other signal in the circuit. Also it consists in means for automatically regulating the movement, or correcting the time of the different clocks or time-trains in the circuit, and keeping them in unison with a central clock for each circuit located at the central office; likewise in means to shunt the circuit around the electro-magnet of each signal while the said signal is inoperative, thus effecting economy of battery power.

315. "Apparatus for generating, controlling, and utilising electricity for lighting, &c." W. R. LAKE. (A communication from E. J. Houston and E. Thomson.) Dated January 23. 1s. The first part of this invention relates to improvements in dynamo-electric machines, particularly in the use of field-magnets. Constructed as a hollow rectangular frame of iron, upon two sides of which are round coils, in such a manner as to cause the remaining sides of the frame to become of opposite polarity. The said invention also relates to improvements in regulators for electric lamps, especially in employing a shunt or derived circuit for regulating the time or interval of passage of the direct arc current through a small electric motor or engine, which alone directly controls the position of the electrodes. The claims are twenty-nine in number.

350. "Electric lamps." J. P. CELESTIN DE PUYDT and J. COUGNET. Dated January 27. 2d. Consists in the production of light from pieces of carbon, either pine or mixed with other substances, used in a closed vessel in which a vacuum or a partial vacuum is produced. *(Provisional only.)*

351. "Telephones, &c." L. DAVIS. (A communication from E. Marx, F. Aklem, J. Kayser, and A. G. Tisdel, of U.S.A.) Dated January 27. 6d. Consists of an improved telephone, the poles of the permanent magnet of which approach each other closely, one or both poles being surrounded by a helix, and one pole terminating in a thin metallic tongue to be vibrated by the induced magnetism of the helix, or by the vibration of a diaphragm of non-conducting material fitted in contact with the vibrating pole. Also relates to carbon transmitters, and consists in the employment of a diaphragm suspended upon an arm, or as a spring tongue and an adjustable spring arm carrying the carbon contact point; and also in the employment of an induction coil of novel construction.

404. "Effecting electrical connections for telephonic communication." G. WESTINGHOUSE, JUN. Dated January 29. 10d. Relates to means and apparatus whereby the electrical connections can be greatly simplified by making one wire serve for connecting the exchange with a whole group of subscribers, for which purpose, instead of leading the wire from each subscriber of a group all the way to the exchange, it is led to a switch apparatus in the neighbourhood of the group, and the switch is connected by a single wire with the central station; the switch being so arranged that when one subscriber of the group is communicating all other members of the group are excluded.

409. "Switch apparatus for telephonic and telegraphic purposes." W. R. LAKE. (Communicated by T. A. Watson, of Everett, Mass., U.S.A.) Dated January 29. 6d. Consists of a modified switch board.

436. "Apparatus for registering or recording telegraphic signals, &c." C. MCGUIRE BATE. Dated January 31. 2d. Consists of a device by which an observer can register and record marks corresponding with flashed signals transmitted to him without taking his eyes from the transmitting station. *(Provisional only.)*

City Notes.

Old Broad Street, September 14th, 1880.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY, LIMITED.—The forty-sixth ordinary general meeting of the shareholders was held on the 2nd of September, at the City Terminus Hotel, Sir James Carmichael, Bart., chairman, presiding. The report stated that the claim under the guarantee was £3,107, while there had been a slight diminution in the receipts. It having been ascertained by the Treasury that payments to the amount of £1,185 had in former years been paid in excess of its actual liabilities under the guarantee, the department had deducted such sum from the amount now claimed, less the sum of £707 16s. 6d. erroneously deducted from the last payment, and which two amounts would be respectively debited and credited to the reserve fund. They recommended payment of the usual dividend at the rate of 8 per cent. per annum, less income-tax, on the preference stock of the Company, and of three per cent. per annum, free of income-tax, on the ordinary stock of the Company, payable on and after the 7th inst., leaving £462 to be carried to reserve. The receipts from messages in the half-year were £2,036. The Chairman, in moving the adoption of the report, said that the slight delay which had occurred in calling the meeting had arisen from their anxiety to effect a complete settlement before they did meet of the point in dispute between the Treasury and themselves, and he was happy to say that the whole difference had been arranged amicably. The result was, that while the Government had insisted on the old claim of £1,185, which they had overpaid the Company in error some years ago, they had, on the other hand, agreed to waive the claim they made against the Company last year for £707. Putting one against the other the result would be that eventually they would have to pay the Government a sum of £477. He was very glad that the whole matter had now been settled, and without serious loss to the Company; and he thought the accounts had been put on such a footing that no dispute could ever arise again. The report was adopted and the dividends recommended were declared on the motion of the Chairman, seconded by the Hon. Ashley Ponsonby. The retiring directors (Sir James Carmichael, Bart., and the Hon. A. Ponsonby) were afterwards re-elected; and on the motion of the Chairman, seconded by Mr. T. Adam, Mr. Robinson was appointed to fill the vacant seat at the board.—Mr. Robinson, in reply, said they all knew that his desire was to place the Company in an improved position, so as to arrange that by the termination of the engagement they would realise some advantage by an alliance with some other company. The retiring auditor (Mr. Allwright) was re-appointed, and Mr. Hayward was elected the other auditor. A vote of thanks to the Chairman and Directors brought the meeting to a close.

W. T. HENLEY'S TELEGRAPH WORKS CO. LMTD.—The directors of this Company have decided to issue the remaining shares for £28,900 to the public. In their prospectus it is stated that the profitable work done and in hand, will, it is believed, enable the directors to pay a dividend for the first year. The present issue of shares to rank for dividend with those already allotted.

THE negotiations between the Anglo-American Telegraph Company and the Compagnie Française have, up to the present, proved futile, and have, for the time terminated.

IN the House of Commons, the other day, Sir C. Dilke, replying to Mr. Caine, said the attention of the Government had been called to the cutting, by the Chilian authorities, of the submarine telegraph cables laid by the West Coast of America Telegraph Company on the coast of Peru, and the Company had been requested to supply further information. Her Majesty's Government would inquire as to the fact of the neutrality of the cable having been declared.

The following are the final quotations of telegraphs:—Anglo-American Limited, 65¼-65¾; Ditto, Preferred, 96½-97; Ditto, Deferred, 36¼-36¾; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9-9¼; Cuba, Limited, 9¼-9½; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 1⅞-2⅛; Direct Spanish, 10 per cent. Preference, 11⅞-12¼; Direct United States Cable, Limited, 1877, 12½-12⅝; Scrip of Debentures, 106-108; Eastern, Limited, 9⅛-9¼; Eastern 6 per cent. Preference, 12¼-12⅝; Eastern, 6 per cent. Debentures, repayable October, 1883, 106-108; Eastern 5 per cent. Debentures, repayable August, 1887, 103-106; Eastern, 5 per cent., repayable Aug., 1899, 103-106; Eastern Extension, Australasian and China, Limited, 9⅝-10; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-107; Eastern and South African, Limited, 5 per cent., Mortgage Debentures redeemable 1900, 102-104; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 9¼-9½; Globe Telegraph and Trust, Limited, 6⅛-6⅜; Globe, 6 per cent. Preference, 12-12¼; Great Northern, 10-10¼; Indo-European, Limited, 24¾-25¼; London Platino-Brazilian, Limited, 4¼-5; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¾-11¼; Reuter's Limited, 9¼-10¼; Submarine, 240-250; Submarine Scrip, 2¼-2½; West Coast of America, Limited, 2½-2⅝; West India and Panama, Limited, 1⅛-1¼; Ditto, 6 per cent. First Preference, 7⅛-7⅜; Ditto, ditto, Second Preference, 6¾-7¼; Western and Brazilian, Limited, 7⅛-7¾; Ditto, 6 per cent. Debentures "A," ——; Ditto, ditto, ditto, "B," 96-99; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 34½-35; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 15½-16; Ditto 6 per cent. Debenture, 105-107.